

Docket No 64223 (52059)  
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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In re Application of:  
Peter Kammerhofer, Ingolf Mielke, Peter  
Schwarzmeier

Application No.: 10/552,640

Confirmation No.: 9136

Filed: October 7, 2005  
(International filing date: March 17, 2004)

Art Unit: 1621

For: APPARATUS AND PROCESS FOR THE  
PRODUCTION OF VINYL CHLORIDE BY  
THERMAL CRACKING OF 1,2-  
DICHLOROETHANE

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Examiner: Sudhakar Katakam

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**DECLARATION OF DR. MICHAEL BENJE, UNDER 37 C.F.R. § 1.132**

I, Michael Benje, declare as follows:

1. I am Head of Product Development Group, Organic Chemicals and Polymers Division of Uhde GmbH, Friedrich-Uhde-Strasse 15, 44141 Dortmund, Germany. My field of research and expertise is in the area of EDC and VCM technology. I am inventor of several patents relating to the production of Vinyl Chloride.
2. I have carefully studied the above-referenced application (the "Application") and the office action dated May 19, 2008 for the Application rejecting claims 4-15 as allegedly obvious. I have also carefully studied the subject described in the following references.
  - a) US 4,798,914, (corresponding to EP 0 264 065) ("Link et al.");
  - b) US 4,822,932 ("Dummer et al."); and

c) DE 34 40 685.

3. The subject matter of the Application pertains to a process for the production of vinyl chloride by thermal cracking of 1,2-dichloroethane in a cracking furnace in which a medium pressure of from 1.4 to 2.5 MPa is maintained in the system. Further, an externally heatable and separately regulatable heat exchanger is provided which allows for the prevention of pressure and temperature fluctuation in the system.
4. Link et al. is directed to a process for the production of vinyl chloride by thermal cracking of 1,2-dichloroethane wherein the thermal energy of the cracking gas (i.e. the gas leaving the cracking furnace) is utilized to heat liquid 1,2-dichloroethane in a heat exchanger. This heat exchanger according to Link et al. corresponds to the EDC vaporizer 4 as shown in Figure 1, sheet A of the present application. This heat exchanger which is used according to Link et al. is not externally heatable and separately regulatable. Therefore, pressure and temperature fluctuations in the system according to Link et al. can not be prevented. The only way how pressure and temperature fluctuations in the apparatus according to Link et al. can be influenced is by the heat input with the burners. The heat exchanger used by Link et al. is only used to warm up and evaporate the 1,2-dichloroethane (i.e. as a vaporizer).
5. In contrast to this, according to the Application, pressure and temperature fluctuations in the system can be prevented by using an externally heatable and separately regulatable heat exchanger.
6. As can be clearly seen from the Table on page 5 (in the corrected version), the formation of by-products is significantly lower in the process according to the Application when compared with Link et al. This results in a higher yield of 1,2-dichloroethane. Most significantly, the furnace operating time between cleaning periods is nearly twice as high for the process according to the Application when compared with the process according to Link et al. It is to be noted that cleaning of the furnace takes up to two weeks and

therefore, the furnace operating time has a significant influence on the output and the productivity of a process. In the present case, two weeks correspond to a loss of productivity of 2,5%. In total 35 million tons of vinyl chloride are produced every year. Therefore, in the production of a product in such a large scale, an increase of the productivity of only a few percent still has a large influence on the overall costs of the final product.

7. Regarding the process described in DE 34 40 685, i.e. the low-pressure process, it can be clearly seen from the Table on page 5 that this process has a significant higher power consumption than the process according to the Application.
8. The process according to DE 34 40 685 does not use a EDC vaporizer heated by cracking gases. Therefore, in order to compare the total energy consumption of EDC-cracking of this process with the energy consumption of the process according to the Application as well as the process according to Link et al., it is to be noted that in the case of DE 34 40 685 the energy consumption of EDC-vaporization has to be added to the total energy consumption of EDC-cracking. Contrary to this, in the process according to the Application as well as the process according to Link et al., the energy consumption of EDC-vaporization does not have to be added to the total energy consumption of EDC-cracking due to a heat exchanger which is used as EDC-vaporizer.
9. Therefore, the actual total energy consumption of the EDC-cracking including the energy consumption of EDC-vaporization in kW/t is 904 in the process according to the Application, 890 in the process according to Link et al. and 1178 according to DE 34 40 685. Therefore, the energy consumption is 30% higher in the process according to DE 34 40 685 when compared to the process according to the Application.
10. In addition to this total energy consumption mentioned above, also the refrigeration output for liquefying the hydrogen chloride at the top of the HCl column is much lower in the process according to the Application than in the process according to DE 34 40 685.

Further, electricity has to be used as energy for liquefying the hydrogen chloride which additionally involves much higher costs for energy.

11. Therefore, this tabular presentation clearly shows that the method according to the Application makes it possible to obtain the decisive advantages of low-pressure-cracking, a high yield, a low rate of by-product formation and a long operating time of the furnace combined with a low-energy consumption that bears comparison with high-pressure cracking.

12. The following table shows the cost advantage associated with the Application when compared to the processes of the prior art:

	Application	EP 0264065	DE 3440685
Δ Raw material yield	0	1.1 €/to VCM	0.1 €/to VCM
Δ Energy consumption	0.9 €/to VCM	0	14.7 €/to VCM
	0	+ 0.2 €/to VCM	+ 18.8 €/to VCM

The costs associated with the process of the Application are 0.2 €/ton lower than for the process according to Link et al. and 18,8 €/ton lower than for the process of DE 34 40 685. Taking into consideration an annual production of 35 Mio. tons of VCM this leads to an advantage of 7 Mio. € over Link et al. and 658 Mio € over DE 34 40 685. It is to be noted that the costs associated with the larger furnace operating time compared to Link et al. are not included in these costs.

14. Dummer et al. has no relevance to the Application. Dummer et al. does not deal with the cracking process itself but it relates to the technology after the quench column. Therefore, this patent deals with a completely different aspect of the technology, quite distinct from the Application and therefore a person skilled in the art would not refer to Dummer et al. when trying to optimise the process according to Link et al.

15. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful statements may jeopardize the validity of the application or any patent issued thereon.

Date: 29. JULY 2008

Respectfully Submitted,

By: Michael Benji